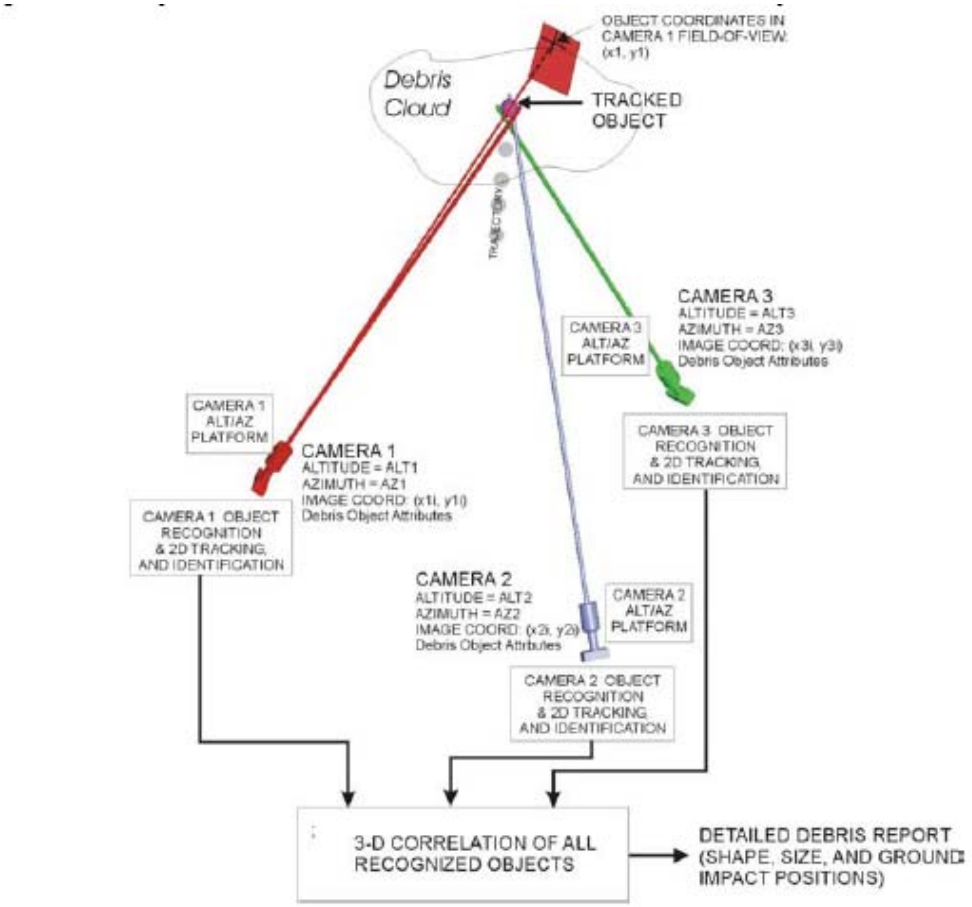
NASA Range Safety Program
2006 Annual Report

EMERGING TECHNOLOGY
AUTOMATED OPTICAL TRACKING AND THREE DIMENSIONAL OBJECT RECOGNITION

Most launch accidents happen shortly after lift-off when the vehicle is still within a few tens of kilometers from the launch pad. In this region, an optical system for tracking and identifying debris may be more versatile and less costly than conventional radars. A Phase II Small Business Innovation Research contract has been awarded to OPTRA, Inc. to develop techniques to track and construct three-dimensional views of tumbling objects in the atmosphere or space using digital optical tracking images for a variety of missions. These views will be used to determine the approximate geometric sizes and shapes of the objects.

Potential Application

The potential application is to help track and identify debris quickly after an accident or flight anomaly as shown in the diagram below. The data will be provided by sequential digital images from one or more tracking cameras, ideally operating autonomously. The goal is to track and identify between 50 to 100 objects with typical cross-sections varying from tens of square meters down to one square meter or less within several minutes after an accident.



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Phase I Investigation

During the initial Phase I investigation that ended in 2006, OPTRA developed object detection, tracking, and identification algorithms and successfully tested these algorithms on computer-generated objects of various shapes and sizes and on sample real-world image sequences of a Delta II booster separation. OPTRA also determined the minimum size that can be imaged using current technology, the probability of correctly estimating an object's size and shape using identifier qualifiers for each shape class, the resolution capability for accurate identification, and quantified the processing speed and the means for transmitting analyzed data to the command center.

Phase II Goals

The goals of the Phase II effort include the following:

- Refining the detection, tracking, and identification algorithms
- Developing a robust optical system using commercial off-the-shelf equipment
- Investigating the affects of noise, obscurations, viewing angle, tracking errors on the identification probabilities
- Field testing of the system and algorithms by tracking and identifying recreational parachutists